

The following listing of claims replaces all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): An apparatus for modifying the concentration of a predetermined substance present in a first fluid flowing through a conduit having an inner surface and a longitudinal axis, the apparatus comprising:

a first plurality of hollow fiber membrane modules, each module including:

a plurality of elongated hollow fiber membranes located generally in adjacent, parallel relationship to each other, wherein each of the hollow fiber membranes includes a generally cylindrical wall defining an interior surface and an exterior surface, and further defining a first end and a second end, wherein each of the cylindrical walls is configured to transmit the predetermined substance therethrough, between its interior surface and its exterior surface, and

a module housing that supports the plurality of elongated hollow fiber membranes with their first ends arranged in adjacent relationship and with their second ends arranged in adjacent relationship, wherein a transverse flow path is defined past the exterior surfaces of the hollow fiber membranes,

wherein the first plurality of hollow fiber membrane modules are located within the conduit and mated with each other, in alignment along the longitudinal axis thereof;

a second plurality of hollow fiber membrane modules located within the conduit and mated with each other, in alignment along the longitudinal axis thereof and downstream of the first plurality of hollow fiber membrane modules, wherein each module of the second plurality of modules is substantially the same as the modules of the first plurality of modules;

a baffle assembly located within the conduit and configured to direct the flow of the first fluid initially to the first plurality of hollow fiber membrane modules, where the fluid flows along parallel flow paths simultaneously through such modules, and thereafter along a common path to the second plurality of hollow fiber membrane modules, where the fluid flows along parallel flow paths simultaneously through such modules, wherein in each case the fluid flows through the module along the transverse flow path past the exterior surfaces of the plurality of

elongated hollow fiber membranes; and

a fluid source that ~~directs~~ delivers a second fluid to ~~flow through~~ the plurality of elongated hollow fiber membranes of each module of the first and second plurality of hollow fiber membrane modules and that directs the second fluid to flow through each hollow fiber membrane, from their its first ends end to their its second ends end;

wherein the predetermined substance is transmitted through the cylindrical walls of the plurality of elongated hollow fiber membranes of each hollow fiber membrane module, to modify the concentration of the predetermined substance in the first fluid.

Claim 2 (canceled).

Claim 3 (previously presented): The apparatus according to claim 1, wherein the hollow fiber membranes are made of a material selected from the group comprising polypropylene, polyvinylidene fluoride, and Teflon®.

Claim 4 (original): The apparatus according to claim 1, wherein the conduit is a cylindrical pipe.

Claim 5 (previously presented): The apparatus according to claim 1, wherein the module housing of each module of the first and second pluralities of hollow fiber membrane modules comprises:

a first membrane housing located adjacent to the first ends of the hollow fiber membranes that is coupled to the first ends of the hollow fiber membranes;

a first end plate located adjacent to the first ends of the hollow fiber membranes and connected to the first membrane housing;

a second membrane housing located adjacent to the second ends of the hollow fiber membranes that is coupled to the second ends of the hollow fiber membranes;

a second end plate located adjacent to the second ends of the hollow fiber membranes and connected to the second membrane housing; and

a first side support connected between the first membrane housing and the second membrane housing that maintains a position of the first membrane housing relative to the second membrane housing.

Claim 6 (previously presented): The apparatus according to claim 5, wherein the module housing of each module of the first and second pluralities of hollow fiber membrane modules further comprises a second side support connected between the first membrane housing and the second membrane housing.

Claim 7 (previously presented): The apparatus according to claim 5, wherein the module housing of each module of the first and second pluralities of hollow fiber membrane modules further comprises a material that fills spaces between the first ends of the hollow fiber membranes, couples the first ends of the hollow fiber membranes to the first membrane housing, fills other spaces between the second ends of the hollow fiber membranes, and couples the second ends of the hollow fiber membranes to the second membrane housing.

Claim 8 (original): The apparatus according to claim 7, wherein the material is selected from the group comprising epoxy, silicon, and urethane.

Claim 9 (previously presented): The apparatus according to claim 5, wherein the module housing of each module of the first and second pluralities of hollow fiber membrane modules further comprises:

- a first O-ring positioned between the first membrane housing and the first end plate before the first end plate is secured to the first membrane housing that provides a first seal between the first membrane housing and the first end plate; and

- a second O-ring positioned between the second membrane housing and the second end plate before the second end plate is secured to the second membrane housing that provides a second seal between the second membrane housing and the second end plate.

Claim 10 (previously presented): The apparatus according to claim 5, wherein the module housing of each module of the first and second pluralities of hollow fiber membrane modules further comprises:

- a first tube fitting connected to the first end plate; and
- a second tube fitting connected to the second end plate.

Claim 11 (previously presented): The apparatus according to claim 5, wherein the baffle assembly includes a flow divider connected to the first membrane housing of each module of the first and second pluralities of hollow fiber membrane modules, to direct the flow of the first fluid after the first fluid flows past the hollow fiber membranes of such module.

Claim 12 (previously presented): An apparatus for modifying the concentration of a predetermined substance present in a first fluid flowing through a conduit having an inner surface, the apparatus comprising:

- a first hollow fiber membrane module including

- a plurality of elongated hollow fiber membranes located generally in adjacent, parallel relationship to each other, wherein each of the hollow fiber membranes includes a generally cylindrical wall defining an interior surface and an exterior surface, and further defining a first end and a second end, wherein each of the cylindrical walls is configured to transmit the predetermined substance therethrough, between its interior surface and its exterior surface, and

- a module housing that supports the plurality of elongated hollow fiber membranes with their first ends arranged in adjacent relationship and with their second ends arranged in adjacent relationship, wherein a transverse flow path is defined past the exterior surfaces of the hollow fiber membranes, wherein the module housing includes

- a first membrane housing located adjacent to the first ends of the hollow fiber membranes that is coupled to the first ends of the hollow fiber membranes,

- a first end plate located adjacent to the first ends of the hollow fiber membranes and connected to the first membrane housing,

- a second membrane housing located adjacent to the second ends of the hollow fiber membranes that is coupled to the second ends of the hollow fiber membranes,

a second end plate located adjacent to the second ends of the hollow fiber membranes and connected to the second membrane housing, and

a first side support connected between the first membrane housing and the second membrane housing that maintains a position of the first membrane housing relative to the second membrane housing,

wherein the first hollow fiber membrane module is configured to be positionable within the conduit and further to be matable with a similarly configured hollow fiber membrane module;

a baffle assembly located within the conduit and including a flow divider connected to the first membrane housing that directs the flow of the first fluid through the first hollow fiber membrane module, along the transverse flow path past the exterior surfaces of the plurality of elongated hollow fiber membranes, wherein the flow divider includes a plurality of flow vanes; and

a fluid source that directs a second fluid to flow through the plurality of elongated hollow fiber membranes, from their first ends to their second ends;

whereby the predetermined substance is transmitted through the cylindrical walls of the plurality of elongated hollow fiber membranes, to modify the concentration of the predetermined substance in the first fluid.

Claim 13 (previously presented): An apparatus for modifying the concentration of a predetermined substance present in a first fluid flowing through a conduit having an inner surface, the apparatus comprising:

a first hollow fiber membrane module including

a plurality of elongated hollow fiber membranes located generally in adjacent, parallel relationship to each other, wherein each of the hollow fiber membranes includes a generally cylindrical wall defining an interior surface and an exterior surface, and further defining a first end and a second end, wherein each of the cylindrical walls is configured to transmit the predetermined substance therethrough, between its interior surface and its exterior surface, and

a module housing that supports the plurality of elongated hollow fiber membranes with their first ends arranged in adjacent relationship and with their second ends arranged in adjacent relationship, wherein a transverse flow path is defined past the exterior surfaces of the hollow fiber membranes, wherein the module housing includes

a first membrane housing located adjacent to the first ends of the hollow fiber membranes that is coupled to the first ends of the hollow fiber membranes,

a first end plate located adjacent to the first ends of the hollow fiber membranes and connected to the first membrane housing,

a second membrane housing located adjacent to the second ends of the hollow fiber membranes that is coupled to the second ends of the hollow fiber membranes,

a second end plate located adjacent to the second ends of the hollow fiber membranes and connected to the second membrane housing, and

a first side support connected between the first membrane housing and the second membrane housing that maintains a position of the first membrane housing relative to the second membrane housing,

wherein the first hollow fiber membrane module is configured to be positionable within the conduit and further to be matable with a similarly configured hollow fiber membrane module;

a baffle assembly located within the conduit and including a flow divider connected to the first membrane housing and a module guide connected to the flow divider, for directing the flow of the first fluid through the first hollow fiber membrane module, along the transverse flow path past the exterior surfaces of the plurality of elongated hollow fiber membranes; and

a fluid source that directs a second fluid to flow through the plurality of elongated hollow fiber membranes, from their first ends to their second ends;

whereby the predetermined substance is transmitted through the cylindrical walls of the plurality of elongated hollow fiber membranes, to modify the concentration of the predetermined substance in the first fluid.

Claim 14 (original): The apparatus according to claim 13, further comprising a module guide runner connected to the module guide.

Claim 15 (original): The apparatus according to claim 13, wherein:
the conduit includes a rib connected to the inner surface; and
the module guide interfaces with the rib.

Claim 16 (previously presented): The apparatus according to claim 5, wherein the baffle assembly comprises:

a separate input flow diversion assembly located adjacent to each module of the first and second pluralities of hollow fiber membrane modules, each such input flow diversion assembly configured to direct the flow of the first fluid into the associated hollow fiber membrane module; and

a separate output flow diversion assembly located adjacent to each module of the first and second pluralities of hollow fiber membrane modules, with each module located between its associated input output flow diversion assemblies, wherein each output flow diversion assembly is configured to direct the flow of the first fluid leaving its associated hollow fiber membrane module.

Claim 17 (previously presented): The apparatus according to claim 16, wherein:

each of the input flow diversion assemblies includes an upper portion configured to interface with the inner surface of the conduit; and

each of the output flow diversion assemblies includes a lower portion configured to interface with the inner surface of the conduit.

Claim 18 (previously presented): The apparatus according to claim 16, wherein each module of the first and second pluralities of hollow fiber membrane modules further includes a flow divider connected to the module's first membrane housing and configured to direct the flow of the first fluid after the first fluid flows past the module's hollow fiber membranes.

Claim 19 (previously presented): The apparatus according to claim 18, wherein each module of the first and second pluralities of hollow fiber membrane modules further includes a module guide connected to the associated flow divider.

Claim 20 (previously presented): The apparatus according to claim 19, wherein:

the conduit includes a rib connected to its inner surface; and

the module guide of each module of the first and second pluralities of hollow fiber membrane modules interfaces with the rib.

Claim 21 (currently amended): An apparatus for modifying the concentration of a predetermined substance present in a first fluid flowing through a conduit having an inner surface, the apparatus comprising:

a first stage and an adjacent second stage through which the first fluid flows, wherein each of the first stage and the second stage includes a hollow fiber membrane module including:

a plurality of elongated hollow fiber membranes located generally in adjacent, parallel relationship to each other, wherein each of the hollow fiber membranes includes a generally cylindrical wall defining an interior surface and an exterior surface, and further defining a first end and a second end, wherein each of the cylindrical walls is configured to transmit the predetermined substance therethrough, between its interior surface and its exterior surface, and

a module housing that supports the plurality of elongated hollow fiber membranes with their first ends arranged in adjacent relationship and with their second ends arranged in adjacent relationship, wherein a transverse flow path is defined past the exterior surfaces of the hollow fiber membranes,

wherein the hollow fiber membrane module is configured to be positionable within the conduit and further to be matable with a similarly configured hollow fiber membrane module;

a first flow diversion assembly located within the conduit between the first and second stages and configured to direct the flow of the first fluid into the first stage and direct the flow of the first fluid leaving the second stage;

a second flow diversion assembly located within the conduit adjacent to the first stage, with the first stage located between the first flow diversion assembly and the second flow diversion assembly, wherein the second flow diversion assembly is configured to direct the flow of the first fluid leaving the first stage;

a third flow diversion assembly located within the conduit and adjacent to the second stage, with the second stage located between the first flow diversion assembly and the third diversion assembly, wherein the third flow diversion assembly is configured to direct the flow of the first fluid into the second stage; and

a fluid source that ~~directs~~ delivers a second fluid to ~~flow through~~ the plurality of elongated hollow fiber membranes and that directs the second fluid to flow through each such hollow fiber membrane, from ~~their~~ its first ~~ends~~ end to ~~their~~ its second ~~ends~~ end;

whereby the predetermined substance is transmitted through the cylindrical walls of the plurality of elongated hollow fiber membranes, to modify the concentration of the predetermined substance in the first fluid as the first fluid flows past the exterior surfaces of the plurality of elongated hollow fiber membranes.

Claim 22 (original): The apparatus according to claim 21, wherein:

the first flow diversion assembly includes an upper portion;
each of the second flow diversion assembly and the third flow diversion assembly includes a lower portion; and

the upper portion and the lower portions are designed to interface with the inner surface of the conduit.

Claim 23 (original): The apparatus according to claim 21, further comprising a module guide connected to the hollow fiber membrane module in each of the first stage and the second stage.

Claim 24 (original): The apparatus according to claim 23, wherein:

the conduit includes a rib connected to the inner surface; and
the module guide interfaces with the rib.

Claim 25 (canceled).

Claim 26 (previously presented): The apparatus according to claim 1, wherein one hollow fiber membrane module of the first plurality of hollow fiber membrane modules further includes a flow divider connected to the one hollow fiber membrane module that directs the flow of the first fluid after the first fluid flows past the hollow fiber membranes of the one hollow fiber membrane module.

Claim 27 (previously presented): The apparatus according to claim 1, further comprising:

a first flow diversion assembly located adjacent to the first plurality of hollow fiber membrane modules and configured to direct the flow of the first fluid into the first plurality of hollow fiber membrane modules; and

a second flow diversion assembly located adjacent to the first plurality of hollow fiber membrane modules, with the first plurality of hollow fiber membrane modules located between the first flow diversion assembly and the second flow diversion assembly, wherein the second flow diversion assembly is configured to direct the flow of the first fluid leaving the first plurality of hollow fiber membrane modules toward the second plurality of hollow fiber membrane modules.

Claims 28-32 (canceled).